NON-PUBLIC?: N
ACCESSION #: 8812210365
LICENSEE EVENT REPORT (LER)

FACILITY NAME: Trojan Nuclear Plant PAGE: 1 OF 7

DOCKET NUMBER: 05000344

TITLE: Reactor Trip as a Result of Feedwater Valve Controller Failure
EVENT DATE: 11/13/88 LER #: 88-043-00 REPORT DATE: 12/13/88

OPERATING MODE: 1 POWER LEVEL: 100

THIS REPORT IS SUBMITTED PURSUANT TO THE REQUIREMENTS OF 10 CFR SECTION
50.73(a)(2)(iv)

LICENSEE CONTACT FOR THIS LER:
NAME: John D. Guberski, Compliance Engineer TELEPHONE: (503) 556-3713

COMPONENT FAILURE DESCRIPTION:
CAUSE: X SYSTEM: JB COMPONENT: FC MANUFACTURER: W120
C TC RV T095
REPORTABLE TO NPRDS: Yes
No

SUPPLEMENTAL REPORT EXPECTED: NO EXPECTED SUBMISSION DATE:

ABSTRACT:

On November 13, 1988 with the plant in Mode 1 at 100% power, with the Reactor Coolant System at Tavg 585 degrees Fahrenheit, 2235 psig, the 'B' steam generator main feedwater regulating valve controller failed. This resulted in a reactor trip at 1053 due to a turbine trip on Hi-Hi steam generator level. The valve controller failure was due to a power supply failure. Immediate corrective action was to carry out Emergency Instruction (EI)-O Reactor Trip, Safety Injection and Diagnosis and to restore steam generator level.

At 1159 an evacuation of a portion of the turbine building was ordered, and main steam isolation manually initiated, due to a report of a steam leak in the turbine building. The source of the leak was found to be a bonnet/body leak of main turbine gland seal steam relief valve (PSV-3589). The leak was due to poor material condition of the valve (loose studs/nuts) and failure of two bonnet/body studs from low cycle, high stress, fatigue. The valve was rebuilt and similiar valves were checked to determine their condition (found acceptable).

During post trip work it was discovered that one steam generator blowdown isolation valve had failed to close on a feedwater isolation signal. The cause was determined to be an instantaneous breaker overload setting which was within specification but did not have enough margin to prevent undesirable trips. All steam generator blowdown isolation valves were declared inoperable, closed, and power removed. After an engineering evaluation, the instantaneous trip settings were adjusted from the middle to the high of the setpoint range. This event had no effect on public health and safety.
END OF ABSTRACT

Description of Event

On November 13, 1988, the plant was in Mode 1 (100% power operation) with the Reactor Coolant System at 585 degrees Fahrenheit and 2235 psig. At 1052 a 'B' Steam Generator (S/G) Feed Flow/Steam Flow mismatch annunciator alarm occurred, and was followed a minute later by an automatic reactor trip initiated by a turbine trip on Hi Hi Steam Generator Level. During the one minute between the annunciator alarm and the Reactor trip, operations personnel found the 'B' steam generator main feedwater flow regulating valve indicating full open. The operator placed the AUTOMATIC/MANUAL controller in MANUAL and attempted to throttle the valve. Initially the main feed water flow regulating valve responded but stopped at 80% open indication. Operations personnel then assessed the situation and action options. An operator was dispatched to take local manual control of the valve and control the S/G water level. Before the operator arrived at the valve gallery, the plant trip had occurred. Reduction of main feedwater pump speed was rejected due to the affect on the other S/G levels and time needed for a response in level. Use of the block valve for flow control was rejected as the valve would not close sufficiently, in the time available, to cause a change in level before reaching the trip setpoint. Also this type of use of the block valve has not been covered in training. Based on the rapid rise in 'B' S/G water level, operations personnel decided to manually trip the plant. The automatic trip occurred before the manual trip was initiated.

A feedwater isolation occurred on reactor trip coincident with a low Reactor Coolant System Tavg signal. Operators responded to the trip in accordance with Emergency Instruction (EI)-O Reactor Trip, Safety Injection and Diagnosis.

At approximately 1125, operators experienced difficulties in maintaining main turbine gland seal steam header pressure. In accordance with operating procedures, the gland seal steam bypass valve was opened. System pressure held steady for 20 minutes then began to cycle between 2 to 8 psig. Efforts to control the pressure swings continued. An operator on normal rounds reported a

steam leak in the southwest area of the Turbine Building at the 63 foot elevation at 1159. The southwest area of the Turbine Building was evacuated and a manual initiation of main steam isolation performed to isolate the leak. By 1205 the steam leak was identified as coming from a failed relief valve (PSV-3589) in the gland seal steam system. The gland seal steam system was then isolated.

As the trip resulted in actuation of feedwater isolation, per standing orders, testing of certain motor operated valves was done. At 1500, while preparing to test the 'C' S/G blowdown isolation valve (MO-6718), per standing orders, the operator noticed both position indication lights for MO-6718 on the control board were not lit, indicating no power was available to the valve. The operator instructed an electrician to check the breaker for MO-6718. The electrician found the breaker tripped, and, per operator direction, closed the breaker. Upon restoration of power to MO-6718, the operator noted that valve position lights on the control board indicated the valve was still open. This valve should have closed on the feedwater isolation signal which was generated at the time of the plant trip. The second containment isolation valve on the 'C' steam generator was confirmed closed. Investigation of the cause of the breaker trip concluded that the circuit breaker instantaneous trip was set within specification but without enough margin to prevent an undesirable trip. The remaining seven steam generator blowdown isolation valve instantaneous trip setpoints were checked, and found to have the same instantaneous trip setpoint as MO-6718. At 1623 operations personnel declared all the S/G blowdown containment isolation valves inoperable, (MO-6716, MO-6717, MO-6718, MO-6719, MO-2808, MO-2810, MO-2812 and MO-2813), confirmed all eight valves were shut, and removed electrical power to the valves.

Cause of Occurrence

The cause of the 'B' Steam Generator main feedwater flow regulating valve failure was determined to be a failed power supply capacitor in the AUTO/MAN station (Hagan AUTO/MAN Station - Assembly 4111081-G01, Serial Number 121).

The steam leak was caused by the poor material condition of the valve (loose studs/nuts) and failure of two of the gland seal steam relief valve (PSV-3589) bonnet/body studs (Teledyne-Ferris-Type 2575B/SP). One stud showed evidence of a pre-existing crack. All eight studs were sent out for examination to confirm material acceptability and the failure mode of the two failed studs. Valve inlet flange to pipe flange studs were also found loose. See Fig. 1 for valve location.

The metallurgical examination determined the two studs failed due to low cycle, high stress, fatigue. One stud, located between the two failed studs, was

visibly bent. The initial, in place, examination also found one stud with the nut missing and the remaining five studs with the nuts loose.

Based on the metallurgical exam, two failure mechanisms seemed possible, either water hammer or normal system pressure exceeding the strength of weakened bonnet/body studs. Water hammer as a cause was ruled out as

1) No evidence of hanger, insulation or piping damage was found on a system walkdown.

2) The drain bypass flow orifice was operable and would have allowed water to drain from the lines.

3) The main turbine gland seal steam system had been operating on the bypass for approximately an hour before failure of PSV-3589 occurred. This time period was sufficient to allow the lines to properly warm up.

The failure mode of normal system pressure exceeding the strength of weakened body to bonnet studs is supported by conditions found in the plant. Valve PSV-3589 has been found with loose nuts twice in the past, when investigated for lifting early (1 psig and less than 3 psig vs. 120 psig setpoint). Relief valves, PSV-3523 and PSV-3526, downstream of PSVs-3589 did not lift even though their setpoints are 20 psig. Finally strong evidence of cycling exist,as the yoke of PSV-3589 is full of metal "dings", with portions of the metal "mushroomed" over, indicating yielded crushed metal. In addition, the manual handle on the relief valve also appeared to be beaten. A failure scenario is described below, based on this evidence.

The loose nuts would allow relief valve PSV-3589 to lift prematurely. Cyclic lifting would result in cyclic loading of bonnet to body studs, leading to failure. The pressure swings in the gland seal steam system confirm cyclic operation of valve PSV-3589 occurred. Also, two independent observers noted the stack for PSV-3589 relieving steam and also no steam from stacks for PSV-3525 and PSV-3526). Conservative calculations showed that a gland steam seal system pressure of approximately 63 psig would provide sufficient stud loading to fail the valve body to bonnet studs weakened by low cycle, high stress fatigue loading. An actual failure pressure of less than 20 psig is probable.

The cause of the S/G blowdown isolation valve breaker instantaneous overload trip was determined to be caused by the in rush current in the first few cycles being high enough to exceed the trip point on some valve operations. After an

engineering evaluation of the setpoint, it was determined that, on occasion, the in rush current during the subtransient period could exceed the instantaneous overload trip setpoint that had been selected for the valve. Further evaluation showed that the existing setpoint was at the middle of the allowable range for the setpoint.

Corrective Action

The immediate corrective action following the reactor trip was to carry out the emergency instruction recovery actions and restore 'B' Steam Generator level to normal. After maintenance personnel determined the AUTO/MAN control station to not be operating, the controller was replaced with a spare unit. Subsequent investigation found the controller to have a failed power supply, due to a failed capacitor. A review of equipment history was conducted and no similar cases were seen. Discussions were then held and an evaluation of other Auto/Manual stations was deemed necessary. A listing was made of other applications and their importance to continued plant operation was evaluated. This review indicated that failure of FK-510, 520, 530, and 540 were of greatest concern and had potential detrimental effects on plant operation. The capacitor was replaced in these power supplies as a plant trip prevention measure.

The immediate corrective action to the report of extensive steam in the southwest portion of the 63 foot elevation of the turbine building was to evacuate the turbine building, manually initiate Main Steam Isolation, and locate/isolate the source of the leak. Permanent corrective actions were assembled in an action plan. The key points of the action plan were:

1) Inspect PSV-3589 for cause of failure, with metallurgical examination of studs.

2) Inspect equipment in the area of the steam leak to determine if any equipment was damaged (none found).

3) cheek bonnet stud nuts and flange stud nuts on downstream 20 psi relief valves PSV-3625 and PSV-3626. One nut moved more than two flats. Several nuts had less than one flat of movement.
Remaining nuts were tight!.

4) Randomly check bolt tightness on other relief valves in the plant.

Six valves checked - no loose studs/nuts!.

5) Initiate periodic maintenance of gland seal steam relief valves, nut tightness (body to bonnet and inlet/outlet flange), following

return to power. CTL 21895!.

6) Monitor steam seal operation on next start up and shut down to further determine cause of failure. Monitoring of the system during startup uncovered problems in maintaining system pressure at a given value. The cause of the pressure oscillation appears to be control problems with the gland seal steam unloader valves. Solutions are being developed CTL 21896!.

7) Used star washer to provide a means of locking nuts when valve was repaired.

The immediate action upon finding the 'C' steam generator blowdown valve open was to confirm the redundant containment isolation valve closed. The immediate corrective action for finding the steam generator blowdown valve breaker tripped was to close all the steam generator blowdown isolation valves, remove power to the valve operators and declare the valves inoperable. Permanent corrective action was to change the instantaneous overload trip setpoint from the middle to the high end of the allowable setpoint range following an engineering evaluation.

Significance of Occurrence

This event had no effect on public health and safety.

FIGURE OMITTED - NOT KEYABLE (DRAWING)

ATTACHMENT 1 TO 8812210365 PAGE 1 OF 1

PGE
Portland General Electric Company December 13, 1988
Trojan Nuclear Plant CAO-396-88
71760 Columbia River Hwy
Rainier, Oregon 97048
(503) 556-3713

US Nuclear Regulatory Commission
Document Control Desk
Washington, D.C. 20555

Gentlemen:

Licensee Event Report No. 88-43 is attached. This report discusses an event in which a reactor trip resulted from the failure of the controller for a main feedwater flow control valve.

Sincerely,

C. A. Olmstead
General Manager
Trojan Nuclear Plant

c: Mr. John B. Martin
Regional Administrator
US Nuclear Regulatory Commission

Mr. Bill Dixon
State of Oregon
Department of Energy

Mr. R. C. Barr
USNRC Resident Inspector
Trojan Nuclear Plant

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